Table 230-1—Ice thickness for purposes of calculating clearances

	Clearance zone (for use with Rules 232, 233, 234, and 235)		
	Zone 1	Zone 2	Zone 3
Radial thickness of ice			
(mm)	12.5	6.5	0
(in)	0.50	0.25	0

Table 230-2—Ice, wind pressures, temperatures, and additive constants for purposes of calculating final inelastic deformation

	Clearance zone (for use with Rule 230B)		
	Zone 1	Zone 2	Zone 3
Radial thickness of ice			
(mm)	12.5	6.5	0
(in)	0.50	0.25	0
Horizontal wind pressure			
(Pa)	190	190	430
(lb/ft^2)	4	4	9
Temperature			
(°C)	–20	–10	–1
(°F)	0	+15	+30
Constant to be added to the resultant			
(N/m)	4.40	2.90	0.73
(lb/ft)	0.30	0.20	0.05

231. Clearances of supporting structures from other objects

Supporting structures, support arms, anchor guys, and equipment attached thereto, and braces shall have the following clearances from other objects. The clearance shall be measured between the nearest parts of the objects concerned.

A. From fire hydrants

Not less than 1.2 m (4 ft).

EXCEPTION 1: Where conditions do not permit, a clearance of not less than 900 mm (3 ft) is allowed.

3. Conductors shall be arranged so that the vertical spacing shall be not less than that specified in Table 235-8 under the conditions specified in Rule 235C2b(1)(c)
4. A supporting neutral conductor of a supply cable meeting Rule 230C3 or an effectively grounded messenger of a supply cable meeting Rule 230C1 or 230C2 may attach to the same insulator or bracket as a neutral conductor meeting Rule 230E1, so long as the clearances of Table 235-8 are maintained in mid-span and the insulated energized conductors are positioned away from the open supply neutral at the attachment.

H. Clearance and spacing between communication conductors, cables, and equipment

1. The spacing between messengers supporting communication cables should be not less than 300 mm (12 in) except by agreement between the parties involved.
2. The clearances between the conductors, cables, and equipment of one communication utility to those of another, anywhere in the span, shall be not less than 100 mm (4 in), except by agreement between the parties involved.

I. Clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure

1. General

Communication antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space in accordance with the applicable rules of Sections 42 and 44. See also Rule 224A.

2. Communication antenna

The clearance between a communication antenna operated at a radio frequency of 3 kHz to 300 GHz and a supply line conductor shall be not less than the value given in Table 235-6, row 1b.

NOTE 1: The antenna functions as a rigid, vertical, or lateral open wire communication conductor.

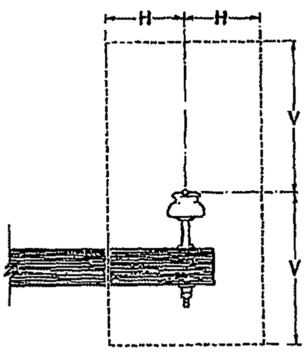
NOTE 2: See Rule 420Q.

3. Equipment case that supports a communication antenna

The clearance between an equipment case that supports a communication antenna and a supply line conductor shall be not less than the value given in Table 235-6, Row 4a.

4. Vertical or lateral communication conductors and cables attached to a communication antenna

The clearance between a supply line conductor and the vertical or lateral communication conductor and cable attached to a communication antenna shall be not less than the value given in Rule 239.



V = Vertical clearance

H = Horizontal clearance

Figure 235-1—Clearance diagram for energized conductor

in

Table 235-6— *(continued)*
Clearance in any direction from line conductors to supports and to vertical or lateral conductors, span, or guy wires attached to the same support

[See also Rules 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures; neutral conductors meeting Rule 230E1 (in)	Supply lines Circuit phase-to-phase voltage		
			0 to 8.7 kV ⑭ (in)	Over 8.7 to 50 kV (in)	Over 50 to 814 kV ④⑨ (in)
4. Surface of structures:					
a. On jointly used structures	—	5 ②⑥	5 ③⑧	5 plus 0.2 per kV in excess of 8.7 kV ⑧⑩	13 plus 0.2 per kV in excess of 50 kV
b. All other	3 ②⑥	—	3 ⑧	3 plus 0.2 per kV in excess of 8.7 kV ⑧⑩	11 plus 0.2 per kV in excess of 50 kV

①For guy wires, if practical. For clearances between span wires and communication conductors, see Rule 238C.

On jointly used structures, guys that pass within 12 in of supply conductors, and also pass within 12 in of communication cables, shall be protected with a suitable insulating covering where the guy passes the supply conductors, unless the guy is effectively grounded or insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.

The clearance from an insulated or effectively grounded guy to a communication cable may be reduced to 3 in when abrasion protection is provided on the guy or communication cable.

②Communication conductors may be attached to supports on the sides or bottom of crossarms or surfaces of poles with less clearance.

③This clearance applies only to supply conductors at the support below communication conductors, on jointly used structures.

Where supply conductors are above communication conductors, this clearance may be reduced to 3 in.

④All clearances for line over 50 kV shall be based on the maximum operating voltage. For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235E3.

⑤For supply circuits of 0 to 750 V, this clearance may be reduced to 3 in.

⑥A neutral conductor meeting Rule 230E1 may be attached directly to the structure surface.

⑦Guys and messengers may be attached to the same strain plates or to the same through bolts.

⑧For open supply circuits of 0 to 750 V and supply cables of all voltages meeting Rule 230C1, 2 or 3, this clearance may be reduced to 1 in. No clearance is specified for phase conductors of such cables where they are physically restrained by a suitable bracket from abrasion against the pole.

⑨The additional clearance for voltages in excess of 50 kV specified in Table 235-6 shall be increased 3% for each 1000 ft in excess of 3300 ft above mean sea level.

⑩Where the circuit is effectively grounded and the neutral conductor meets Rule 230E1, phase-to-neutral voltage shall be used to determine the clearance from the surface of support arms and structures.

⑪These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

⑫Phase-to-phase voltages shall be determined according to Rule 235A3.

⑬These clearances apply to communication antennas operated at a radio frequency of 3 kHz to 300 GHz. Also see Rules 235I4 and 239.

⑭Does not include neutral conductors meeting Rule 230E1.

in

Table 235-6—
Clearance in any direction from line conductors to supports and to vertical or lateral conductors, span, or guy wires attached to the same support

[See also Rules 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures; neutral conductors meeting Rule 230E1 (in)	Supply lines Circuit phase-to-phase voltage 0 to 8.7 kV [14] (in)	Supply lines Circuit phase-to-phase voltage Over 8.7 to 50 kV (in)	Supply lines Circuit phase-to-phase voltage Over 50 to 814 kV [4] [9] (in)
1. Vertical and lateral conductors:					
a. Of the same circuit	3	3	3	3 plus 0.25 per kV in excess of 8.7 kV	No value specified
b. Of other circuits [12] [13]	3	3	6 [5]	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
2. Span or guy wires,[11] or messengers attached to same structure:					
a. When parallel to line	3 [7]	6 [1] [7]	12 [1]	12 plus 0.4 per kV in excess of 8.7 kV	29 plus 0.4 per kV in excess of 50 kV
b. Anchor guys	3 [7]	6 [1] [7]	6 [7]	6 plus 0.25 per kV in excess of 8.7 kV	16 plus 0.25 per kV in excess of 50 kV
c. All other	3 [7]	6 [1] [7]	6	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
3. Surface of support arms	3 [2] [6]	3 [2] [6]	3 [8]	3 plus 0.2 per kV in excess of 8.7 kV [8] [10]	11 plus 0.2 per kV in excess of 50 kV

Table 235-8—Vertical spacing between conductors supported on vertical racks or separate brackets

Span length		Vertical spacing between conductors	
(m)	(ft)	(mm)	(in)
0 to 45	0 to 150	100	4
Over 45 to 60	Over 150 to 200	150	6
Over 60 to 75	Over 200 to 250	200	8
Over 75 to 90	Over 250 to 300	300	12

EXCEPTION: The vertical spacing between open wire conductors may be reduced where the conductors are held apart by intermediate spacers, but may not be less than 100 mm (4 in).

236. Climbing space

The following requirements apply only to portions of structures that workers ascend.

A. Location and dimensions

1. A climbing space having the horizontal dimensions specified in Rule 236E shall be provided past any conductors, support arms, or other parts.
2. The climbing space need be provided on one side or corner of the support only.
3. The climbing space shall extend vertically past any conductor or other part between levels above and below the conductor as specified in Rules 236E, F, G, and I, but may otherwise be shifted from any side or corner of the support to any other side or corner.

B. Portions of supporting structures in climbing space

Portions of the supporting structure, when included in one side or corner of the climbing space, are not considered to obstruct the climbing space.

C. Support arm location relative to climbing space

RECOMMENDATION: Support arms should be located on the same side of the pole.

EXCEPTION: This recommendation does not apply where double crossarms are used on any pole or where crossarms on any pole are not all parallel.

D. Location of equipment relative to climbing space

1. All supply and communication equipment such as transformers, regulators, capacitors, cable terminals (potheads), amplifiers, loading coils, antennas, surge arresters, switches, etc., when located below conductors or other attachments, shall be mounted outside of the climbing space.
2. All exposed ungrounded conductive parts of luminaires and their supports that are not insulated from current-carrying parts shall be maintained at not less than 500 mm (20 in) from the surface of their supporting structure.

   EXCEPTION 1: This may be reduced to 125 mm (5 in) if located on the side of the structure opposite the designated climbing space.

   EXCEPTION 2: This does not apply where the equipment is located at the top or other vertical portion of the structure that is not subject to climbing.

E. Climbing space between conductors

Climbing space between conductors shall be not less than the horizontal dimensions specified in Table 236-1. These dimensions are intended to provide a clear climbing space of 600 mm (24 in) while the conductors bounding the climbing space are covered with temporarily installed protective covering rated for the voltage involved. The climbing space shall be provided both along and across the line and shall be projected vertically not less than 1.0 m (40 in) above and below the limiting conductors. Where communication conductors are above supply conductors of more than 8.7 kV to ground or 15 kV line to line, the climbing space shall be projected vertically at least 1.50 m (60 in) above the highest supply conductors.

EXCEPTION 1: This rule does not apply if it is the unvarying practice of the employers concerned to prohibit employees from ascending beyond the conductors or equipment of a given line or structure unless the conductors or equipment are de-energized and grounded per Rule 444D.

EXCEPTION 2: For supply conductors carried on a structure in a position below communications facilities in the manner permitted in Rule 220B2, the climbing space need not extend more than 600 mm (2 ft) above such supply space.

EXCEPTION 3: If the conductors are owned, operated, or maintained by the same utility, the climbing space may be provided by temporarily moving the line conductors using live-line tools.

F. Climbing space on buckarm construction

Method of providing climbing space on buckarm construction

The full width of climbing space shall be maintained on buckarm construction and shall extend vertically in the same position at least 1.0 m (40 in) [or 1.50 m (60 in) where required by Rule 236E] above and below any limiting conductor.

A six-pin crossarm having pin spacing of 370 mm (14.5 in) may be used to provide a 750 mm (30 in) climbing space on one corner of a junction pole by omitting the pole pins on all arms, and inserting pins midway between the remaining pins so as to give a spacing of 185 mm (7.25 in), provided that all of the following conditions are met:

1. Circuits are less than 8.7 kV to ground or 15 kV line to line
2. Span lengths do not exceed 45 m (150 ft)
3. Sags do not exceed 380 mm (15 in) for wires of AWG No. 2 and larger sizes, or 750 mm (30 in) for wires smaller than AWG No. 2
4. Each conductor on the end of every arm is tied to the same side of its insulator
5. The spacing on the next pole is not less than 370 mm (14.5 in)

G. Climbing space past longitudinal runs not on support arms

The full width of climbing space shall be provided past longitudinal runs and shall extend vertically in the same position from 1.0 m (40 in) below the run to a point 1.0 m (40 in) above [or 1.50 m (60 in) where required by Rule 236E]. The width of climbing space shall be measured from the longitudinal run concerned. Longitudinal runs on racks, or cables on messengers, are not considered as obstructing the climbing space if the location, size, and quantity of the cables permit qualified workers to climb past them. This does not apply where communication conductors are above the longitudinal runs concerned.

EXCEPTION 1: If a supply longitudinal run is placed on the side or corner of the supporting structure where climbing space is provided, the width of climbing space shall be measured horizontally from the center of the structure to the nearest supply conductors on support arms, under both of the following conditions:

(a) Where the longitudinal run consists of neutral conductors meeting Rule 230E1, open supply conductors carrying not more than 750 V, or supply cables and conductors meeting Rule 230C, all voltages; and is supported close to the structure as by brackets, racks, or pins close to the structure

(b) Where the nearest supply conductors on support arms are parallel to and on the same side of the structure as the longitudinal run and within 1.20 m (4 ft) above or below the run

EXCEPTION 2: For supply conductors carried on a structure in a position below communications facilities in the manner permitted in Rule 220B2, the climbing space need not extend more than 600 mm (2 ft) above such supply space.

EXCEPTION 3: A service drop less than 750 V and meeting Rule 230C is not considered to obstruct the climbing space if all conductors concerned are covered by rubber protective equipment or otherwise guarded as an unvarying practice before workers climb past them, provided that such a service drop is (1) not closer to the longitudinal run at the point of attachment than the diameter of the pole plus 125 mm (5 in) measured horizontally, and (2) not closer than 950 mm (38 in) measured horizontally to the longitudinal run at a point 750 mm (30 in) on the run measured from the point of attachment at the pole. See Figure 236-1.

H. Climbing space past vertical conductors

Vertical runs physically protected by suitable conduit or other protective covering and securely attached without spacers to the surface of the line structure are not considered to obstruct the climbing space.

I. Climbing space near ridge-pin conductors

The climbing space specified in Table 236-1 shall be provided above the top support arm to the ridge-pin conductor but need not be carried past it.

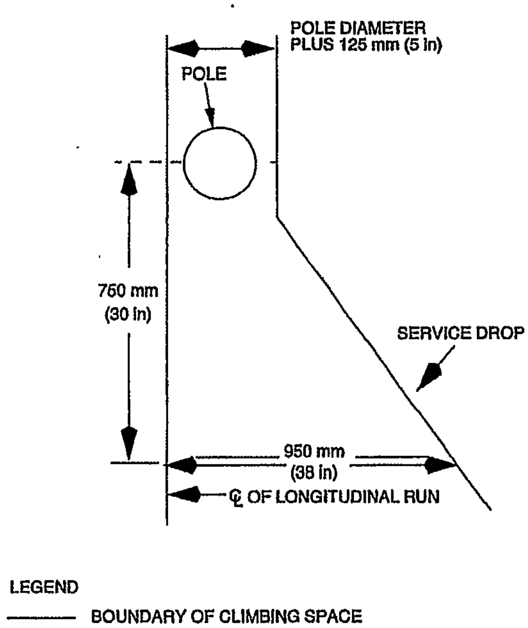


Figure 236-1—Rule 236G, *Exception 3*

Table 236-1— Horizontal clearance between conductors bounding the climbing space

(All voltages are between the two conductors bounding the climbing space except for communication conductors, which are voltage to ground. Where the two conductors are in different circuits, the voltage between conductors shall be the arithmetic sum of the voltages of each conductor to ground for a grounded circuit, or phase to phase for an ungrounded conductor. *See also Rule 236E.*)

Character of conductors adjacent to climbing space	Voltage of conductors	Horizontal clearance between conductors bounding the climbing space ③							
		On structures used solely by				On jointly used structures			
		Communication conductors		Supply conductors		Supply conductors above communication conductors		Communication conductors above supply conductors ①	
		(m)	(in)	(m)	(in)	(m)	(in)	(m)	(in)
1. Communication conductors	0 to 150 V	0.60	No requirements		—		②	0.60	No requirements
	Exceeding 150 V		24 recommended		—		②		24 recommended
2. Supply cables meeting Rule 230C1	All voltages				—		②		No requirements
3. Supply cables meeting Rule 230C2 or 3	All voltages	—	—	0.60	24	0.60	24	0.75	30
4. Open supply line conductors and supply cables meeting Rule 230D	0 to 750 V	—	—	0.60	24	0.60	24	0.75	30
	750 V to 15 kV	—	—	0.75	30	0.75	30	0.75	30
	15 kV to 28 kV	—	—	0.90	36	0.90	36	0.90	36
	28 kV to 38 kV	—	—	1.00	40	1.00	40		
	38 kV to 50 kV	—	—	1.17	46	1.17	46		
	50 kV to 73 kV	—	—	1.40	54	1.40	54		
	Exceeding 73 kV	—	—	>1.40	>54				

①This relation of levels in general is not desirable and should be avoided.

②Climbing space shall be the same as required for the supply conductors immediately above, with a maximum of 0.75 m (30 in) except that a climbing space of 0.41 m (16 in) across the line may be employed for communication cables or conductors where the only supply conductors at a higher level are secondaries (0 to 750 V) supplying airport or airway marker lights or crossing over the communication line and attached to the pole top or to a pole-top extension fixture.

③Attention is called to the operating requirements of Rules 441A and 446C, Part 4, of this Code.

237. Working space

A. Location of working spaces

Working spaces shall be provided on the climbing face of the structure at each side of the climbing space.

B. Dimensions of working spaces

1. Along the support arm

   The working space shall extend from the climbing space to the outmost conductor position on the support arm.

2. At right angles to the support arm

   The working space shall have the same dimension as the climbing space (see Rule 236E). This dimension shall be measured horizontally from the face of the support arm.

3. Vertically

   The working space shall have a height not less than that required by Rule 235 for the vertical separation of line conductors carried at different levels on the same support.

C. Location of vertical and lateral conductors relative to working spaces

The working spaces shall not be obstructed by vertical or lateral conductors. Such conductors shall be located on the opposite side of the pole from the climbing side or on the climbing side of the pole at a distance from the support arm at least as great as the width of climbing space required for the highest voltage conductors concerned. Vertical conductors enclosed in suitable conduit may be attached on the climbing side of the structure.

D. Location of buckarms relative to working spaces

Buckarms may be used under any of the following conditions, provided the climbing space is maintained. Climbing space may be obtained as in Rule 236F.

1. Standard height of working space

   Lateral working space of the height required by Table 235-5 shall be provided between the crossing or tap line conductors attached to the buckarm and the main line conductors. This may be accomplished by increasing the spacing between the line support arms, as shown in Figure 237-1.

2. Reduced height of working space

   Where no circuits exceeding 8.7 kV to ground or 15 kV line to line are involved and the clearances of Rules 235B1a and 235B1b are maintained, conductors supported on buckarms may be placed between line conductors having normal vertical spacing, even though such buckarms obstruct the normal working space, provided that a working space of not less than 450 mm (18 in) in height is maintained either above or below line conductors and buckarm conductors.

   EXCEPTION: The above working space may be reduced to 300 mm (12 in) if both of the following conditions exist:

   (a) Not more than two sets of the line arms and buckarms are involved

   (b) Working conditions are rendered safe by providing rubber protective equipment or other suitable devices to insulate and cover line conductors and equipment that are not being worked upon

E. Guarding of energized equipment

Exposed energized parts of equipment such as switches, circuit breakers, surge arresters, etc., shall be enclosed or guarded if all of the following conditions apply:

1. The equipment is located below the top conductor support
2. The equipment is located on the climbing side of the structure
3. The requirements of Rule 441, Part 4, of this Code cannot be met

F. Working clearances from energized equipment

All parts of equipment such as switches, fuses, transformers, surge arresters, luminaires and their support brackets, etc., or other connections that may require operation or adjustment while energized and exposed at such times, shall be so arranged with respect to each other, other equipment, vertical and lateral conductors, and portions of the supporting structure, including supporting platforms or structural members, that in adjustment or operation no portion of the body, including the hands, need be brought closer to any exposed energized parts or conductors than permitted in Part 4, Rule 441 or 446 of this Code.

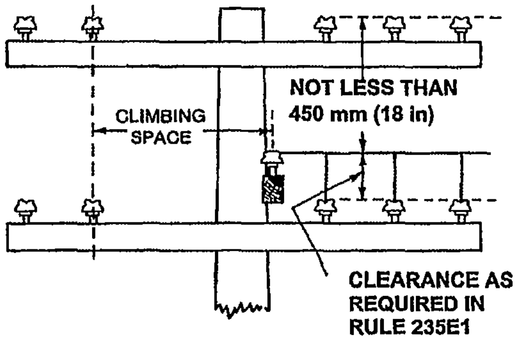


Figure 237-1—Obstruction of working space by buckarm

238. Vertical clearance between certain communications and supply facilities located on the same structure

A. Equipment

For the purpose of measuring clearances under this rule, equipment shall be taken to mean non-current-carrying metal parts of equipment, including metal supports for cables or conductors, and metal support braces that are attached to metal supports or are less than 25 mm (1 in) from transformer cases or hangers that are not effectively grounded.

B. Clearances in general

Vertical clearances between supply conductors and communications equipment, between communication conductors and supply equipment, and between supply and communications equipment shall be as specified in Table 238-1, except as provided in Rule 238C.

C. Clearances for span wires or brackets

Span wires or brackets carrying luminaires, traffic signals, or trolley conductors shall have at least the vertical clearances in millimeters or inches from communications equipment set forth in Table 238-2.

D. Clearance of drip loops of luminaire or traffic signal brackets

If a drip loop of conductors entering a luminaire bracket or traffic signal bracket from the surface of the structure is above a communication cable, the lowest point of the loop shall be at least 300 mm (12 in) above communication cable or through bolt.

EXCEPTION: The above clearance may be reduced to 75 mm (3 in) if the loop is covered by a suitable nonmetallic covering that extends at least 50 mm (2 in) beyond the loop.

E. Communication worker safety zone

The clearances specified in Rules 235C and 238 create a communication worker safety zone between the facilities located in the supply space and facilities located in the communication space, both at the structure and in the span between structures. Except as allowed by Rules 238C, 238D, and 239, no supply or communication facility shall be located in the communication worker safety zone.

Table 238-1—Vertical clearance between supply conductors and communications equipment, between communication conductors and supply equipment, and between supply and communications equipment

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definitions section for voltages of other systems. See also Rule 238B.)

Supply voltage (kV)	Vertical clearance	
	(m)	(in)
1. Grounded conductor and messenger hardware and supports	0.75	30
2. 0 to 8.7	1.00	40 ①
3. Over 8.7	1.00 plus 0.01 per kV in excess of 8.7 kV	40 plus 0.4 per kV ① in excess of 8.7 kV

①Where non-current-carrying parts of supply equipment are effectively grounded and the associated neutral meeting Rule 230E1 or supply cables meeting Rule 230C1 (including the support brackets) are bonded to communication messengers at intervals meeting Rule 92C through out well-defined areas and where communication is at lower levels, clearances may be reduced to 0.75 m (30 in).

Table 238-2—Vertical clearance of span wires and brackets from communication lines

(See also Rule 238C.)

	Carrying luminaires or traffic signals				Carrying trolley conductors			
	Not effectively grounded		Effectively grounded		Not effectively grounded		Effectively grounded	
	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
Above communication support arms	500	20 ①	500	20 ①	500	20 ①	500	20 ①
Below communication support arms	1000	40 ③	600	24	600	24	600	24
Above messengers carrying communication cables	500	20 ①	100	4	300	12	100	4
Below messengers carrying communication cables	1000	40 ④	100	4	300	12	100	4
From terminal box of communication cable	500	20 ①	100	4	300	12 ②	100	4
From communication brackets, bridle wire rings, or drive hooks	410	16 ①	100	4	100	4	100	4

①This may be reduced to 300 mm (12 in) for either span wires or metal parts of brackets at points 1.0 m (40 in) or more from the structure surface.

②Where it is not practical to obtain a clearance of 300 mm (1 ft) from terminal boxes of communication cables, all metal parts of terminals shall have the greatest possible clearance from fixtures or span wires including all supporting screws and bolts of both attachments.

③This may be reduced to 600 mm (24 in) for luminaires and traffic signals operating at less than 150 V to ground.

④This may be reduced to 500 mm (20 in) for luminaires and traffic signals operating at less than 150 V to ground.

239. Clearance of vertical and lateral facilities from other facilities and surfaces on the same supporting structure

Vertical and lateral conductors shall have the clearances required by this rule from other facilities or surfaces on the same supporting structure.

A. General

1. Grounding conductors, surge-protection wires, neutral conductors meeting Rule 230E1, insulated communication conductors and cables, supply cables meeting Rule 230C1 or 350B, insulated supply cables of 0 to 750 V, or conduits may be placed directly on the supporting structure. These conductors, wires, cables, and conduits shall be securely attached to the surface of the structure. Cables not in conduit shall be installed in such a manner as to avoid abrasion at the point of attachment.

2. Installation of supply cable and communication cable in same duct or U-guard type covering

   a. Supply cables 0 to 600 V may be installed together in the same duct or U-guard, if all of the cables are operated and maintained by the same utility.

   b. Supply cables exceeding 600 V meeting Rule 230C1 may be installed together in the same duct or U-guard if all of the cables are operated and maintained by the same utility.

   c. Supply cables 0 to 600 V and supply cables exceeding 600 V meeting Rule 230C1 may be installed together in the same duct or U-guard if all of the cables are operated and maintained by the same utility.

   d. Supply cables shall not be installed in the same duct or U-guard with communication cables unless all of the cables are operated and maintained by the same utility.

   e. Communication cables may be installed together in the same duct or U-guard provided all utilities involved are in agreement.

3. Paired communication conductors in rings may be attached directly to a structure or messenger.

4. Insulated supply circuits of 600 V or less and not exceeding 5000 W may be placed in the same cable with control circuits with which they are associated.

5. The term nonmetallic covering as used in Rule 239 refers to material other than a cable jacket that provides an additional barrier against physical contact.

6. Where guarding and protection are required by other rules, either conduit or U-guards may be used.

B. Location of vertical or lateral conductors relative to climbing spaces, working spaces, and pole steps

Vertical or lateral conductors shall be located so that they do not obstruct climbing spaces, or lateral working spaces between line conductors at different levels, or interfere with the safe use of pole steps.

EXCEPTION: This rule does not apply to portions of the structure that workers do not ascend while the conductors in question are energized.

NOTE: See Rule 236H for vertical runs in conduit or other protective covering.

C. Conductors not in conduit

Conductors not encased in conduit shall have the same clearances from conduits as from other surfaces of structures.

EXCEPTION: Vertical runs of effectively grounded supply conductors may have a clearance of 25 mm (1 in).

H. Requirements for vertical communication conductors passing through supply *space on jointly used structures*

All vertical runs of communication conductors passing through supply space shall be installed as follows:

1. Metal-sheathed communication cables

   Vertical runs of metal-sheathed communication cables shall be covered with suitable nonmetallic material, where they pass trolley feeders or other supply line conductors. This nonmetallic covering shall extend from a point 1.0 m (40 in) above the highest trolley feeders or other supply conductors, to a point 1.80 m (6 ft) below the lowest trolley feeders or other supply conductors, but need not extend below the top of any mechanical protection that may be provided near the ground.

   EXCEPTION 1: Communication cables may be run vertically on the pole through space occupied by railroad signal supply circuits in the lower position, as permitted in Rule 220B2, without covering within the supply space.

   EXCEPTION 2: Covering is not required in the supply space on metallic or concrete supporting structures.

2. Communication conductors

   Vertical runs of insulated communication conductors shall be covered with suitable nonmetallic material, to the extent required for metal-sheathed communication cables in Rule 239H1, where such conductors pass trolley feeders or supply conductors.

   EXCEPTION 1: Communication conductors may be run vertically on the structure through space occupied by railroad-signal supply circuits in the lower position, as permitted in Rule 220B2, without covering within the supply space.

   EXCEPTION 2: Covering is not required in the supply space on metallic or concrete supporting structures.

3. Communication grounding conductors

   Vertical communication grounding conductors shall be covered with suitable nonmetallic material between points at least 1.80 m (6 ft) below and 1.0 m (40 in) above any trolley feeders or other supply line conductors by which they pass.

   EXCEPTION 1: Communication grounding conductors may be run vertically on the structure though space occupied by railroad-signal supply circuits in the lower position, as permitted in Rule 220B2, without covering within the supply space.

   EXCEPTION 2: Covering is not required in the supply space on metallic or concrete supporting structures.

4. Clearance from through bolts and other metal objects

   Vertical runs of communication conductors or cables shall have a clearance of one-eighth of the pole circumference but not less than 50 mm (2 in) from exposed through bolts and other exposed metal objects attached thereto that are associated with supply line equipment.

   EXCEPTION: Vertical runs of effectively grounded communication cables may have a clearance of 25 mm (1 in).

I. Operating rods

Effectively grounded or insulated operating rods of switches are permitted to pass through the communication space, but shall be located outside of the climbing space.

J. Additional rules for standoff brackets

1. Standoff brackets may be used to support the conduit(s). Cable insulation appropriate for the intended service is required; non-metallic conduit shall not be used to meet basic insulation requirements.

   NOTE: See Rule 217A2.

Attachment 3
Declaration of David Marne

Submitted to the New York PSC with NextG's comments in *Proceeding on Motion of the Commission Concerning Wireless Facility Attachments to Utility Distribution Poles*, NY PSC Case No. Case 07-M-0741 (filed Sept. 10, 2007);

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASE 07-M-0741 –	Proceeding on Motion of the Commission Concerning Wireless Facility Attachments to Utility Distribution Poles

DECLARATION OF DAVID MARNE

I, David Marne, do hereby state:

1. I am the company president and senior electrical engineer for Marne and Associates, Inc. in Missoula, Montana, where I specialize in National Electrical Safety Code ("NESC") training and engineering design. I am a registered Professional Engineer and I consult with both the electric and communication utilities on joint use pole attachment engineering issues, including with NextG.

2. I hold a bachelors of science degree in electrical engineering from Montana State University. Currently, I serve on NESC Subcommittee 4, which addresses overhead lines-clearances issues. I am a senior member of the Institute of Electrical and Electronic Engineers, Inc. ("IEEE"). The IEEE is the publisher of the NESC. I am also the author of "McGraw-Hill's National Electrical Safety Code 2007 Handbook," and frequently present seminars on the NESC to a variety of electric power and communication utility professionals. My associate at Marne and Associates, Grant Glaus, is also a registered professional engineer and is on NESC Subcommittee 5, which addresses overhead lines-strength and loading issues.

3. Prior to founding Marne and Associations, I worked as a consulting electrical engineer for 22 years. I have been involved in NESC training for over 10 years.

4. In my role as a consultant to NextG, my company provides consulting on an as requested basis helping NextG assure compliance with the NESC. In that capacity, my company has performed a "typical" pole attachment loading calculation dated Mar. 21, 2007, attached hereto as Exhibit A. A summary of the calculations, which is shown below, indicates that pole line conductors (power and communication) put substantially more load on a pole than vertical antenna and pole top extension structures. Independent of the values, all loads on the structure must be considered when designing a pole line.

Mwp	**3,682** ft-lb moment due to wind on pole
(Sh)(Mwc)	**53,352** ft-lb moment due to wind on conductor (for a 275' span length)
Mwt	**1,449** ft-lb moment due to wind on transformer
Mwa	**777** ft-lb moment due to wind on antenna
Mwpe	**632** ft-lb moment due to wind on pole extension
Mwe	**560** ft-lb moment due to wind on communication equipment box

5. The National Electrical Safety Code ("NESC") addresses communication antennas on the top of power poles and refers to these installations as communication antennas in the supply (power) space. The rules in the NESC, including the rules related to communication antenna installations, are for the safety of electric power and communication workers and the public.

I declare under penalty of perjury that the statements contained in this Declaration are true and corrcct.

David Marne

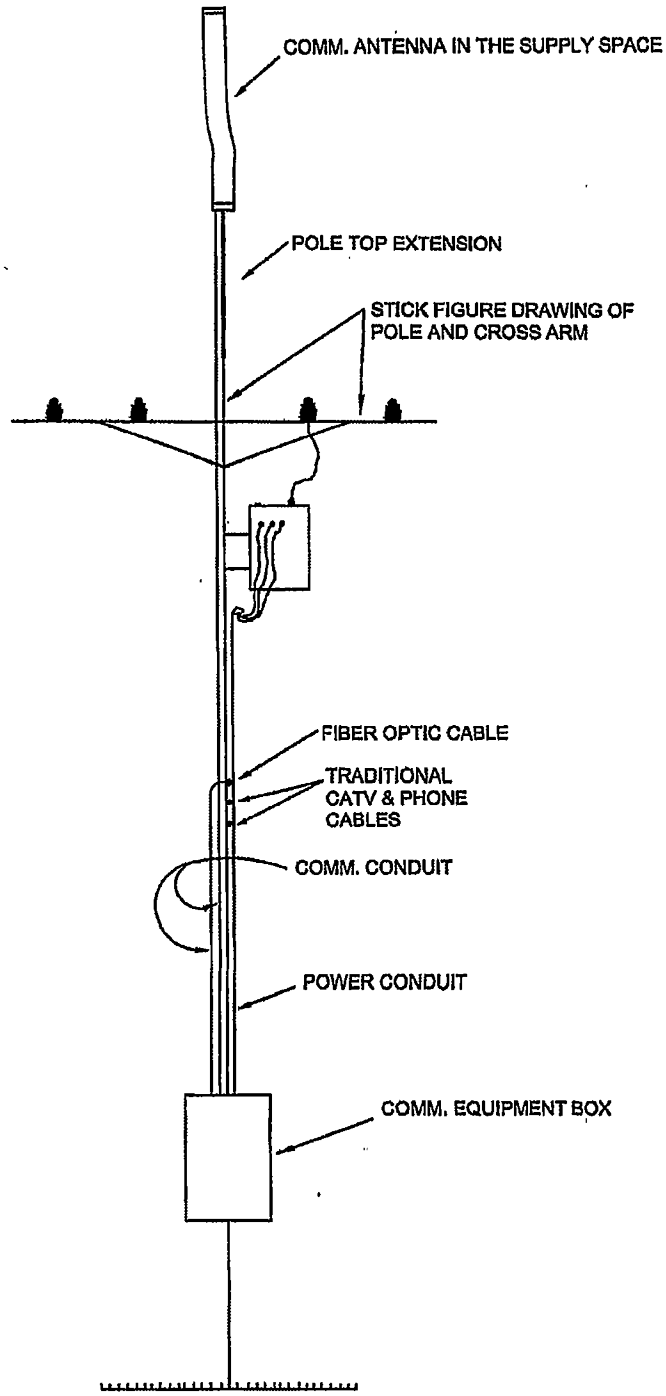
David Marne

Dated September 7, 2007

Exhibit A

POLE LOADING ASSUMPTIONS:

1. 45' CLASS 4 WOOD POLE BURIED 6.5' DEEP.
2. 336 ACSR CONDUCTOR WITH FULL NEUTRAL POSITIONED ON THE CROSS ARM.
3. 275' SPAN ON EACH SIDE OF THE POLE.
4. 57" HIGH, 6.25" DIAMETER ANTENNA WEIGHING 20 LBS.
5. 1-15 KVA TRANSFORMER ON THE POLE.
6. 1-288 COUNT FIBER OPTIC CABLE LASHED TO A 1/4" EHS MESSENGER (275' SPAN).
7. 1-.750 COAX CABLE TV CABLE LASHED TO A 5/16" EHS MESSENGER. (275' SPAN)
8. 1-200 PAIR TELEPHONE CABLE LASHED TO A 5/16" EHS MESSENGER. (275' SPAN)
9. TANGENT POLE (NO LINE ANGLE).
10. COMM. EQUIPMENT BOX SIZE: 48"H X 24"W X 12" D. WEIGHT: 250 LBS. LOCATION: CENTERED 10' ABOVE GROUND.
11. ASSUME EXISTING POLE (PRIOR TO ANTENNA MOUNTING) WAS FRAMED USING RUS "C1" POLE TOP FRAMING.
12. ASSUME THE SAME POLE WAS MODIFIED TO RUS "C9-1" POLE TOP FRAMING AND A 48" POLE TOP EXTENSION WAS ADDED TO THE POLE.
13. ASSUME NESC CLEARANCE ISSUES HAVE BEEN ADDRESSED AND MET (NESC RULES 232, 235C, 235I, 238, 239H, ETC.).
14. ASSUME NESC WORK RULES HAVE BEEN ADDRESSED AND MET (NESC RULES 420Q, ETC.).
15. ASSUME NESC GROUNDING RULES HAVE BEEN ADDRESSED AND MET (NESC SECTION 09).
16. ASSUME POLE TOP EXTENSION, ANTENNA, AND COMM. EQUIPMENT BOX MOUNTING HARDWARE ARE OF ADEQUATE STRENGTH.
17. ASSUME NESC GRADE "C" LOAD AND STRENGTH FACTORS, ASSUME NESC "MEDIUM" LOADING ZONE.
18. ASSUMPTIONS MUST BE MODIFIED TO REFLECT ACTUAL CONDITIONS WHEN CALCULATING ACTUAL INSTALLATIONS.



"TYPICAL" 45' POLE WITH ANTENNA MOUNTED ON POLE TOP
(Not to Scale)

Marne and Associates, Inc. Experts in Electrical Code	Eng/Dwn: DJM/CCM	NEXTG NETWORKS POLE TOP ANTENNA REVIEW	File Name: ANTENNA REVIEW PG1.dwg
	Scale: NOT TO SCALE		Sheet 1 of 4
	Date: 3-21-07		Drawing 1
	Plot: 3-21-07		
	Proj. No: MA-0015		

45-4 Wood Pole with antenna

Load calculations per RUS Distribution Design Guides (Bulletins 1724E-150 through 154)
RUS "C9" Pole-top framing (all four wires on crossarm)
Antenna added on a four-foot pole extension with same diamter as top of pole
NESC Medium Loading District, Grade C

(a) Total ground line moment, including NESC load factors

(1) Pole circumference at ground line

$$C_g = \frac{(L_p - L_g)(C_b - C_t)}{L_p - L_b} + C_t$$

Cg	38.28 in	pole circumference at ground line
Lp	45.0 ft	length of pole
Lg	6.5 ft	distance from pole bottom to groundline
Lb	6.0 ft	distance from pole bottom to classification point (6 ft per ANSI O5.1)
Cb	38.50 in	pole circumference at classification point (Lb)
Ct	21.00 in	pole circumference at pole top

(2) Moment due to wind on pole

$$M_{wp} = F_{OW} W_p \left(\frac{2C_t + C_g}{72\pi}\right) H_p^2$$

Mwp	3682 ft-lb	moment due to wind on pole
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Wp	4.00 lb/ft^2	wind pressure
Ct	21.00 in	pole circumference at pole top
Cg	38.28 in	pole circumference at ground line
Hp	38.5 ft	height of pole top above groundline

(3) Moment due to wind on conductors (per unit length)

$$M_{wc} = F_{ow}\left(\sum W_h H_c\right)$$

(Sh)(Mwc)	53351.54 ft-lb	moment due to wind on conductor (for a 275' span length)
Mwc	194.01 ft-lb/ft	moment due to wind on conductor (per unit length)
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Whp	0.3947 lb/ft	horizontal wind force on phase conductor
Hcp	37.75 ft	height of phase conductor
Whp	0.3947 lb/ft	horizontal wind force on phase conductor
Hcp	37.75 ft	height of phase conductor
Whp	0.3947 lb/ft	horizontal wind force on phase conductor
Hcp	37.75 ft	height of phase conductor
Whn	0.3947 lb/ft	horizontal wind force on neutral conductor
Hcn	37.75 ft	height of neutral conductor
Wht	0.536 lb/ft	horizontal wind force on fiber-optic cables
Hct	29.67 ft	height of cable fiber-optic cables
Wht	0.521 lb/ft	horizontal wind force on cable TV cables
Hct	28.67 ft	height of cable TV cables
Whc	0.738 lb/ft	horizontal wind force on telphone cables
Hcc	27.67 ft	height of telephone cables

(4) Moment due to wind on transformer

$$M_{wt} = F_{ow} W_p A H$$

Mwt	**1449.0** ft-lb	moment due to wind on transformer
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Wp	4.00 lb/ft^2	wind pressure
A	6 ft^2	cross sectional area
H	34.5 ft	mounting height (center of area)

(5) Moment due to wind on antenna

$$M_{wa} = F_{ow} W_p A H$$

Mwa	**777.1** ft-lb	moment due to wind on antenna
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Wp	4.00 lb/ft^2	wind pressure
A	2.474 ft^2	cross sectional area
H	44.875 ft	mounting height (center of area)

(6) Moment due to wind on pole extension

$$M_{wpe} = F_{ow} W_p A H$$

Mwpe	**632.2** ft-lb	moment due to wind on pole extension
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Wp	4.00 lb/ft^2	wind pressure
A	2.23 ft^2	cross sectional area
H	40.5 ft	mounting height (center of area)

(7) Moment due to wind on communication equipment box

$$M_{we} = F_{ow} W_p A H$$

Mwe	**560.0** ft-lb	moment due to wind on communication equipment box
Fow	1.75	NESC load factor for wind loads (Grade C, not at crossing)
Wp	4.00 lb/ft^2	wind pressure
A	8 ft^2	cross sectional area
H	10 ft	mounting height (center of area)

(8) Total ground line moment, including NESC load factors

$$M_g = 1.05\left(M_{wp} + S_h M_{wc} + M_{wt} + M_{wa} + M_{wpe} + M_{we}\right)$$

Mg	**63,475** ft-lb	total ground line moment, including NESC load factors
Sh	275 ft-lb	wind span

(b) Allowable resisting moment of pole, including NESC strength factors

(1) Permitted moment at ground line

$$M_r = F_s K_r F_b C_g^3$$

Mr	**75,499** ft-lb	permitted moment at ground line, including NESC strength factors
Fs	0.85	NESC strength factor
Kr	2.64E-04 ft/in	calculation constant (2.64×10^{-4} ft/in)
Fb	6000 lb/in^2	designated fiber stress
Cg	38.28 in	pole circumference at ground line

(c) Strength requirement of pole

(1) Must be able to withstand expected loads, including load and strength factors

$$M_g \leq M_r$$

Mg ≤ Mr	**yes**	is the pole strength sufficient to withstand the loads?
Mg	63,475 ft-lb	total ground line moment, including NESC load factors
Mr	75,499 ft-lb	permitted moment at ground line, including NESC strength factors

(d) Pole loading summary

	Mwp	**3,682** ft-lb	moment due to wind on pole
	(Sh)(Mwc)	**53,352** ft-lb	moment due to wind on conductor (for a 275' span length)
	Mwt	**1,449** ft-lb	moment due to wind on transformer
	Mwa	**777** ft-lb	moment due to wind on antenna
	Mwpe	**632** ft-lb	moment due to wind on pole extension
	Mwe	**560** ft-lb	moment due to wind on communication equipment box
	Subtotal	**60,452** ft-lb	
Total	Mg	**63,475** ft-lb	total ground line moment, including NESC load factors and RUS 1.05 equipment factor

Attachment 4
Declaration of David Marne

Submitted to the FCC by NextG in the complaint proceeding
NextG Networks of NY, Inc. v. Public Service Electric & Gas
File No. EB-07-MD-004 (filed Feb. 11, 2008)

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

NEXTG NETWORKS OF NY, INC. *Complainant,* v. PUBLIC SERVICE ELECTRIC & GAS COMPANY, *Respondent.*	File No. EB-07-MD-004

REPLY DECLARATION OF DAVID J. MARNE, P.E.

I, David J. Marne, P.E., do hereby state:

1. I am a licensed Professional Engineer and President of Marne and Associates, Inc., an engineering consulting firm. I am a member of National Electrical Safety Code® (NESC®) Subcommittee 4, Overhead Lines-Clearances and I am the author of McGraw-Hill's National Electrical Safety Code® (NESC®) 2007 Handbook. Attached is my Curriculum Vitae (Attachment C).

2. I am executing this Declaration in support of NextG's Reply to the Response of PSE&G in the above-captioned case.

3. Mr. Anthony Ramirez, in his Declaration supporting PSE&G's Response, appears to indicate that safety and reliability concerns should prohibit NextG from mounting communications antennas on PSE&G's poles. The intent of this document is to address statements in Mr. Ramirez's Response. PSE&G appears to be citing National Electrical Safety Code® (NESC®) rules to prohibit the attachment of NextG's communication antenna while in

fact the NESC contains several rules recognizing and providing methods for the safe installation of a communications antenna in the supply space on a pole top. Attached is a point by point review of Mr. Ramirez's Declaration (Attachment A) which I incorporate into my declaration. Also attached are NESC Rules 235I, 239H, and 420Q (Attachment B).

4. It is my opinion that the safety, reliability, and other concerns outlined by Mr. Ramirez on behalf of PSE&G can be resolved or negated using the National Electrical Safety Code (NESC) rules and industry practice.

I declare under penalty of perjury that the information and statements contained in this Declaration are true and correct.

David J. Marne

David J. Marne, P.E.

February 11, 2008

Date

Attachment A

REPLY DECLARATION OF DAVID J. MARNE, P.E.